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April 12, 2005

U.S. Nuclear Regulator Commission
Document Control Desk
Mail Stop 0P1-17
Washington, DC 20555

Subject: 10CFR21 Reporting of Defects and Non-Compliance -
Engine Systems, Inc. Report No. 10CFR21-0089, Rev. 0

Woodward Governor "Compensating" EG Series Actuators

Dear Sir:

The enclosed report addresses a reportable notification about Woodward Governor "Compensating" EG series actuators (Types: EG-R, EG-3C, EG-10C, EGB-2C, EGB-10C, EGB-13C, EGB-29C, EGB-35C and EGB-50C)

A copy of the report has also been sent to the NRC.

Please sign below, acknowledging receipt of this report, and return a copy to the attention of Document Control at the address above (or, fax to number 252/446-1134) within 10 working days after receipt.

Yours very truly,

ENGINE SYSTEMS, INC.

Susan Woolard
Document Control

JE20

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Report No. 10CFR21-0089

Rev. 0: 04/12/05

10CFR21 REPORTING OF DEFECTS AND NON-COMPLIANCE

COMPONENT: Woodward Governor "Compensating" EG Series Actuators
Types: EG-R, EG-3C, EG-10C, EGB-2C, EGB-10C,
EGB-13C, EGB-29C, EGB-35C & EGB-50C

SYSTEM: Governor Systems with EGA and EGM controls

CONCLUSION: Reportable in accordance with 10CFR21.

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Date: 4/12/05

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Date: April 12, 2005

REV	DATE	PAGE	DESCRIPTION

COMPONENT:

Woodward Governor "Compensating" EG Series Actuators

Types: EG-R, EG-3C, EG-10C, EGB-2C, EGB-10C,
EGB-13C, EGB-29C, EGB-35C & EGB-50C

SUMMARY:

Engine Systems Inc. (ESI) has concluded an investigation of a condition reported by the Perry Power Plant with a Woodward Governor EGB-35C governor/actuator. Perry requested that ESI perform a 10CFR21 applicability evaluation of this condition on 2/22/05.

On 2/7/05, the Perry Division 2 EDG failed to hot restart following a 24 hour load endurance run. The failed restart was determined to be a result of a shift in the null voltage setting of the EGB governor to a value of approximately 0 volts. The specification for the null voltage setting is -0.9 to -0.7 volts. The governor is a Woodward Governor type EGB-35C, part number 9903-013, serial number 2261295 (Perry stock code number 13833485). With the null voltage at 0 volts, the actuator did not go to maximum fuel during engine cranking and therefore the engine did not start. The actuator receives its signal from an EGA controller. The EGA is powered by generator output voltage and senses engine speed by monitoring generator output frequency. During engine cranking, generator output voltage is not present; therefore, the EGA is not powered and cannot give an output signal to the actuator. The actuator therefore must move to the maximum fuel position to enable engine starting since the EGA output signal is not available.

The Woodward EG compensating actuator systems with EGA/EGM controls were introduced around 1959. According to Woodward, null voltage drift is a characteristic of the compensating actuators that dates back to the mid to late 1960's. The drift is believed to be caused by a variety of reasons. Thermal effects can cause the actuator's transducer coil resistance to change, the characteristics of the centering restoring spring to change as well expansion of the transducer and pilot valve assembly. Relaxation of spring characteristics over time and changes of internal clearances caused by normal wear could also contribute to null voltage shift. Woodward performed many investigations into the null voltage shift issue but they never determined all the causes. The "proportional" actuator system with the 2301 control was introduced in the mid 1960's. With this system, the 2301 control provides a signal that is proportional to speed/load. With the proportional system introduced, the compensating system was considered obsolete; so further investigation into the null voltage shift issue was abandoned.

Not all compensating actuators experience null voltage drift. Of those where drift has occurred, a shift of approx. 0.3 volts is not uncommon. This small amount of drift would cause a load shift if paralleled with the utility or a frequency change when operating on an isolated bus. Since operability concerns have not been reported in the past, it is assumed that a 0.3 volt shift is not significant enough to affect operability. The null voltage shift that occurred at Perry was approx. 0.7 volts; this changed the actuator from "fail to maximum fuel" to "fail to minimum fuel" which resulted in a start failure. Users with compensating governor systems need to be aware that this characteristic, if significant enough, could affect operability of their safety related system.

AFFECTED USERS:

This notification is applicable to all users with Woodward type EG "compensating" actuators. These systems will only utilize EGA or EGM controls. Since the compensating system has been used on safety related diesel generators and turbines provided by various suppliers, all of ESI's nuclear customers will receive this notification.

DISCUSSION:

Null voltage is used with "compensating" Woodward EG series actuators. The actuators use the Woodward EGA and EGM electronic controls. The EGA controls obtain input power from generator output voltage and sense prime mover speed by monitoring generator output frequency. EGM controls usually are powered from a DC power source and sense prime mover speed via a magnetic pickup monitoring a toothed wheel or gear. The systems are at steady state (rated speed) when operating at the null voltage. The control's output voltage signal will increase or decrease from the null value when it senses a speed change (such as during load transients) to return the prime mover to rated speed. The output voltage will return to the null value once rated speed is obtained. Since the EGA cannot sense speed until the generator builds output voltage, the actuator must go to maximum fuel when a control signal is not present to enable starting of the prime mover; this is known as "fail to maximum fuel". This is not required for starting of EGM systems, since the control will sense speed from the magnetic pickup during cranking of the prime mover. "Fail to maximum fuel" response however is desirable for nuclear safety related applications of both controls since it provides a failsafe mode; that is, the prime mover will go to the high speed setpoint upon loss of the electronic control signal. With "fail to minimum fuel" response, the actuator goes to minimum fuel upon loss of control signal and therefore there is no failsafe mode.

Ideally, the null value would be zero volts to provide equivalent response time in the increase and decrease fuel directions. At zero volts however, the actuator does not recognize the difference between a zero voltage signal (null point) and a loss of control signal. A small offset voltage must therefore be set into the actuator to provide "fail to maximum fuel" or "fail to minimum fuel" response. A negative null voltage results in "fail to maximum fuel" response and a positive null voltage results in "fail to minimum fuel" response. A small offset voltage is utilized to minimize the imbalance between increase fuel and decrease fuel response times. Typically, the null voltage is set at -0.9 to -0.7 volts; however some applications use up to -1.5 volts.

Proportional actuators (EGB-13P, 35P, etc.) have an internal feedback (a mechanical link) between the electrical power piston and electrical section pilot valve. This feedback, which is not provided on the compensating actuators, eliminates the concern of drift because any deviations within the centering restoring spring, pilot valve, etc. are overcome as the power piston and pilot valve come to equilibrium. Reference Figures 1 and 2.

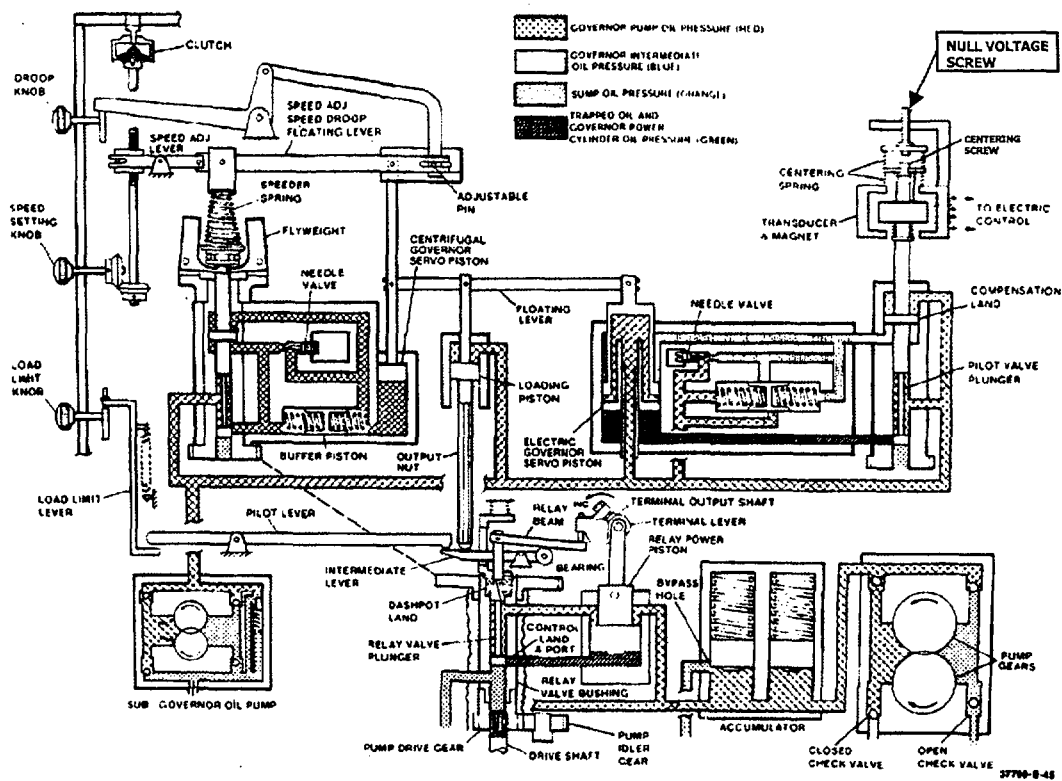


FIGURE 1: TYPICAL EGB-C "COMPENSATING" GOVERNOR

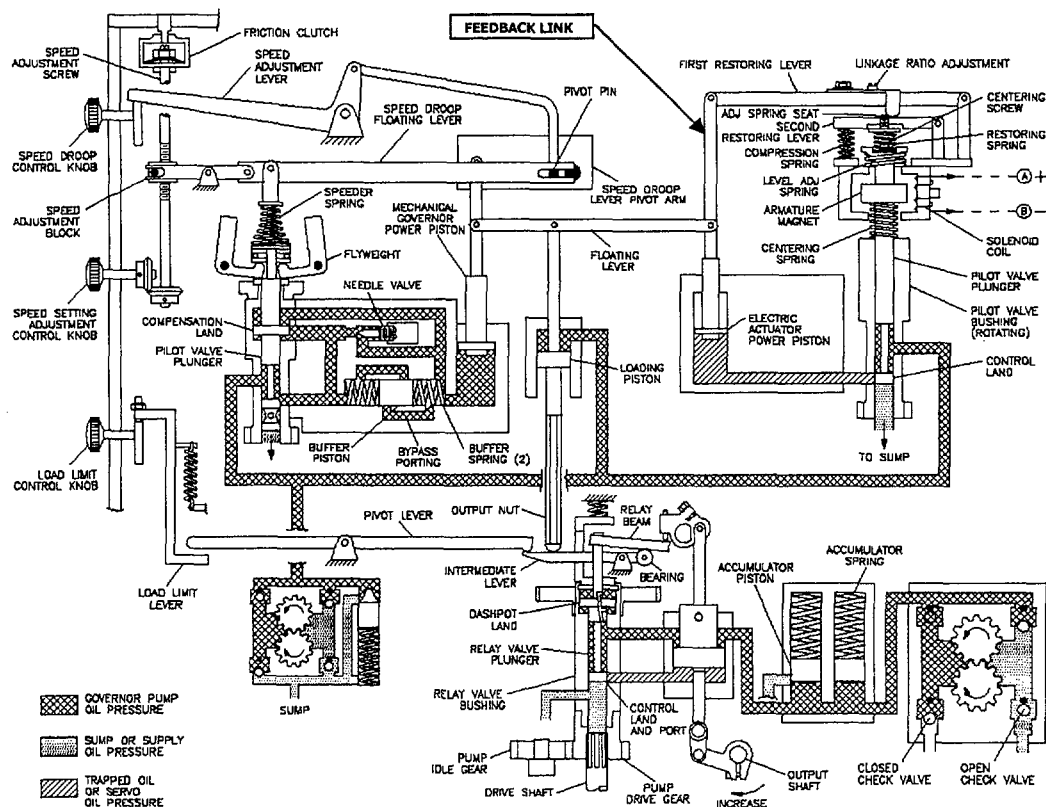


FIGURE 2: TYPICAL EGB-P "PROPORTIONAL" GOVERNOR

CONCLUSION:

The null voltage shift that occurred at Perry changed the actuator from "fail to maximum fuel" to "fail to minimum fuel" and thus resulted in a start failure. Users with compensating governor systems need to be aware that this characteristic, if significant enough, could affect operability of their safety related system.

CORRECTIVE ACTION: (NOTE: This is only applicable EGA and EGM systems.)

1. Short term:

Monitor the actuator's null voltage to verify it is within +/- 0.3 volts of the specification value. Connect a voltmeter to EGA terminals 17(+) & terminal 18(-) or EGM terminals 5(+) & 4(-). Measure the null voltage at the beginning of the run (while the actuator is near standby temp) and later on into the run (when the actuator is at operating temp); these readings should not vary more than 0.3 volts. For most controls, the null voltage should be -0.9 to -0.7 volts at operating temperature. Adjust the null voltage to specification requirements using the procedure listed below. Users may also reference the specific actuator instruction manual.

The recommended frequency to monitor the null voltage is during each surveillance run; however, users may choose to modify this period based upon their experience with their governor systems as it pertains to this issue.

Actuators with null voltage variations greater than 0.3 volts (cold to hot) or those that consistently require null voltage adjustment should be removed for repair or refurbishment.

2. Long term:

Users with compensating governor systems should consider upgrading to a proportional governor system. For EGB-C systems with EGA or EGM controls, the EGB-P and 2301A load sharing and speed control is the recommended replacement. For EG-R systems with EGM controls, the PGPL actuator with a PGPL driver and 505 controller is the recommended replacement.

Null Voltage Adjustment Procedure

1. For EGB actuators, remove the cover. For EG-R actuators, remove the hex head screw on the cover.
2. With the prime mover operating at rated speed and at operating temperature, use a 1/8" "T" handle Allen wrench to turn the null voltage screw to adjust the null voltage to specification requirements.

NOTE: Some older model actuators have a hollow null voltage screw; do not allow the Allen wrench to go through the screw to contact the centering adjustment screw as this could cause abrupt acceleration of the prime mover.

3. With the null voltage adjustment complete, momentarily increase and decrease the prime mover's speed (such as by disturbing the engine fuel rack or the turbine EGR reference input via the EGM/RGSC) to remove any spring wind-up they may have occurred. Readjust the null voltage and repeat if necessary until a consistent (within +/- 0.2 volts of the step 2 setting) value is attained.
4. Replace all covers and/or screws previously removed. Stop the prime mover and restart to verify the null voltage is within +/- 0.2 volts of the step 2 setting.